edibon

Technical Teaching Equipment

Computer Controlled **Catalytic Reactors**

QRCC

① Unit: QRCC. Catalytic Reactors

EDIBON PATENT

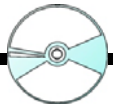
Always included in the supply:

Teaching Technique used

SCADA. EDIBON Computer Control System

② Control Interface Box

③ Data Acquisition Board



④ Software for:
- Computer Control
- Data Acquisition
- Data Management

⑤ Cables and Accessories

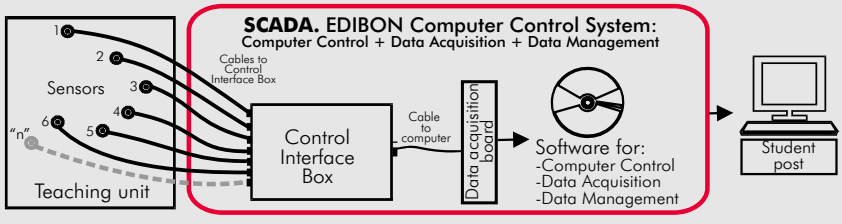
⑥ Manuals

Computer (not included in the supply)

Optional accessory: QRCC-IF. Flow Injection Analysis (FIA) unit

OPEN CONTROL
+
MULTICONTROL
+
REAL TIME CONTROL

Unitary Process Configuration



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Products
Products range
Units
11.-Chemical Engineering

ISO 9001:2000
Certificate of Approval

European Union Certificate

Certificates ISO 14001: 2004 and
ECO-Management and Audit Scheme
(environmental management)

Worlddidac Quality Charter Certificate
Worlddidac Member

DESCRIPTION

In a chemical reaction, the process of catalysis is the increase or decrease in the speed of the chemical reaction (reaction kinetics) caused by what we call a catalyst.

At present, research and development of catalysts are extremely important in the chemistral industry. It is thought that approximately 90% of industry-made chemical products involve some catalytic process in their making.

QRCC unit has been designed to perform the inversion reaction of saccharose, separating its components: glucose and fructose. In order to execute this process, the unit consists of tree fixed-bed reactors that contain different types of catalysts:

Two packed bed reactors for chemical catalysis, composed by acid ion exchange resins.

A biological reactor. (Recommend use with an immobilized enzyme).

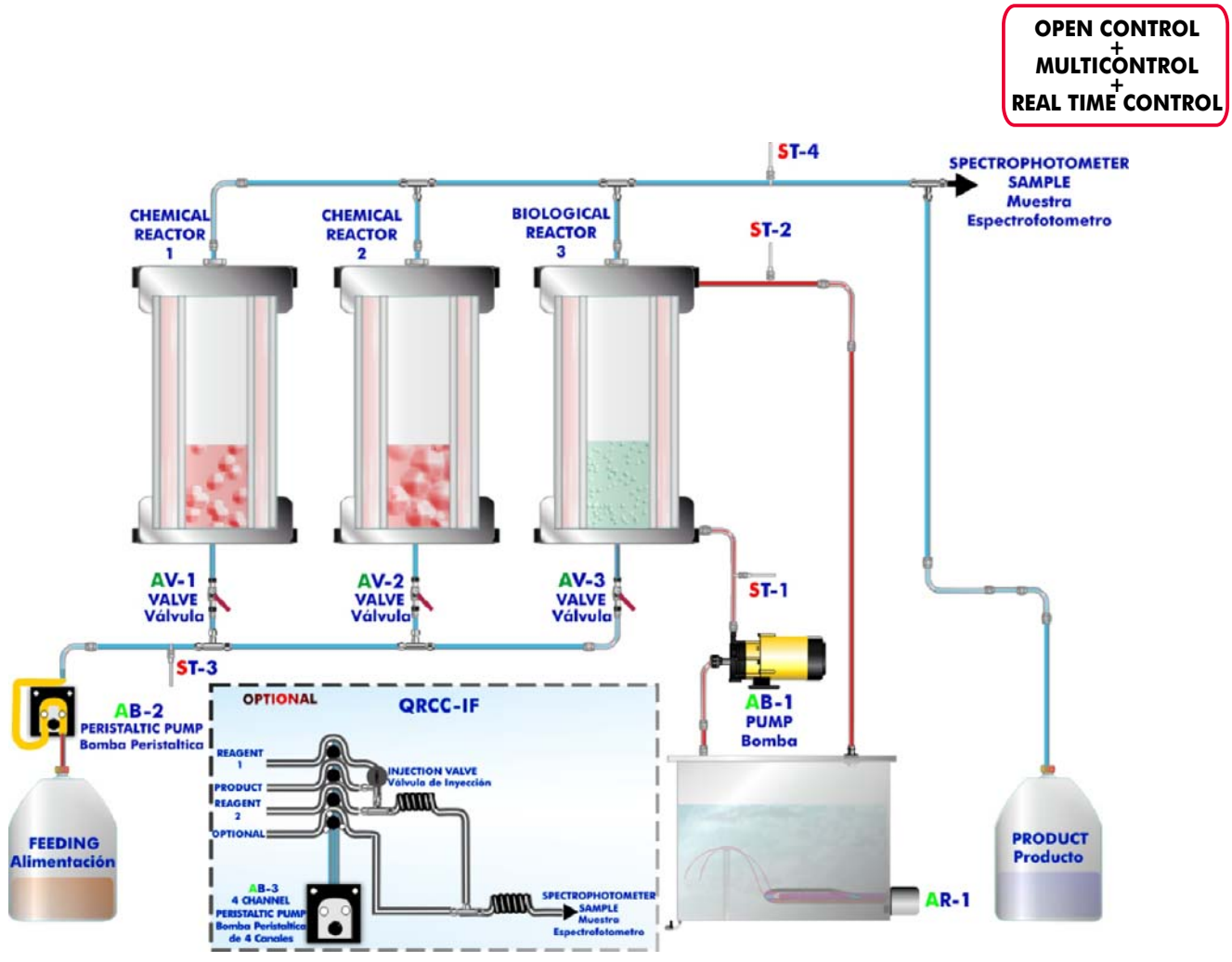
A peristaltic pump with variable speed feeds the reactors' active part with the product. The catalytic process takes place in a continuous way in the fixed bed of the reactors. The reactors' temperature is controlled by an external bath of water that makes it possible to observe the chemical reaction's thermal influence for each setting option.

The resulting solution is pumped to the final-product flask. From this point on it will be analysed with a spectrophotometer that is adapted to QRCC unit interface.

As an optional supply, there is the possibility of acquiring the QRCC-IF unit. It is a Flow Injection Analysis (FIA) unit which is used to determine, in an automatic way, the solution glucose concentration resulting from the carried out experiments.

This Computer Controlled Unit (QRCC) is supplied with the EDIBON Computer Control System (SCADA), including: Control Interface Box + Data Acquisition Board +Computer Control and Data Acquisition Software, for controlling the process and the parameters involved.

PROCESS DIAGRAM AND ELEMENTS ALLOCATION



Note: ST= Temperature sensor. AR= Heating resistance.

Items supplied as standard

① QRCC. Unit:

Bench-top unit.
Anodized aluminium structure and panels in painted steel (epoxy paint).
Main metallic elements in stainless steel.
Diagram in the front panel with similar distribution to the elements in the real unit.
2 glass flacks of 2 litres of capacity, for the initial solution and the final product.
Reactors:
- Two packed bed reactors for chemical catalysis, composed by acid ion exchange resins.
- An enzymatic packed bed reactor. (Recommended use with an immobilized enzyme).
- Reactors diameter: 50 mm.
- Reactors height: 160 mm.
- Material: glass, with a methacrylate cover for protection.

Thermostatic bath, with heating resistance of 600W, controlled by a PID from the computer (PC).
A heated water supply to the reactors jackets allows the automatic control of reaction temperature to a set point value.
Peristaltic pump, with speed regulation, computer controlled, that allows to regulate the feed flow from 0 to 32 ml/min.
4 Temperature sensors, "J" type.
Spectrophotometer, computer controlled, for the final product analysis and absorbance measures:
- Wavelength range: 325-1000 nm.
- Band width: 5 nm.
- Electrical supply: 230V-50Hz.

All electrical circuits are protected by adequate protection devices.

QRCC. Unit

② QRCC/CIB. Control Interface Box:

Control interface box with process diagram in the front panel and with the same distribution that the different elements located in the unit, for an easy understanding by the student. All sensors, with their respective signals, are properly manipulated from -10V. to +10V computer output. Sensors connectors in the interface have different pines numbers (from 2 to 16), to avoid connection errors. Single cable between the control interface box and computer.
The unit control elements are permanently computer controlled, without necessity of changes or connections during the whole process test procedure. **Simultaneously visualization in the computer of all parameters involved in the process. Calibration of all sensors involved in the process.**
Real time curves representation about system responses. Storage of all the process data and results in a file. Graphic representation, in real time, of all the process/system responses.
All the actuators' values can be changed at any time from the keyboard allowing the analysis about curves and responses of the whole process. All the actuators and sensors values and their responses are placed in only one computer screen.
Shield and filtered signals to avoid external interferences.
Real time PID control with flexibility of modifications from the computer keyboard of the PID parameters, at any moment during the process. Real time PID and on/off control for pumps, compressors, resistances, control valves, etc. **Real time PID control for parameters involved in the process simultaneously. Proportional control, integral control and derivative control, based on the real PID mathematical formula, by changing the values, at any time,** of the three control constants (proportional, integral and derivative constants).**Open control** allowing modifications, at any time and in a real time, of parameters involved in the process simultaneously.
Possibility of automatization of the actuators involved in the process.
Three safety levels, one mechanical in the unit, other electronic in control interface and the third one in the control software.

QRCC/CIB

③ DAB. Data Acquisition Board:

PCI Data acquisition board (National Instruments) to be placed in a computer slot. Bus PCI.
Analog input: Number of **channels= 16** single-ended or 8 differential. **Resolution=16 bits**, 1 in 65536.
Sampling rate up to: 250 KS/s (Kilo samples per second). Input range (V)=±10V.
Data transfers=DMA, interrupts, programmed I/0. Number of DMA channels=6.
Analog output: Number of **channels=2**. **Resolution=16 bits**, 1 in 65536. Maximum output rate up to: 833 KS/s.
Output range(V)=±10V. Data transfers=DMA, interrupts, programmed I/0.
Digital Input/Output: Channels=24 inputs/outputs. D0 or DI Sample Clock frequency: 0 to 1 MHz.
Timing: **Counter/timers=2**. Resolution: Counter/timers: 32 bits.

DAB

④ QRCC/CCSOF. Computer Control+Data Acquisition+Data Management Software:

Compatible with actual Windows operating systems. Graphic and intuitive simulation of the process in screen. **Compatible with the industry standards.** Registration and visualization of all process variables in an automatic and simultaneously way. **Flexible, open and multicontrol software**, developed with actual windows graphic systems, acting simultaneously on all process parameters.
Analog and digital PID control. Menu for PID and set point selection required in the whole work range.
Management, processing, comparison and storage of data. Sampling velocity up to 250,000 data per second guaranteed. Calibration system for the sensors involved in the process.
It allows the registration of the alarms state and the graphic representation in real time.
Comparative analysis of the obtained data, after the process and modification of the conditions during the process. **Open software, allowing to the teacher to modify texts, instructions. Teacher's and student's passwords** to facilitate the teacher's control on the student, and allowing the access at different work levels.
This unit allows that the 30 students of the classroom can visualize simultaneously all results and manipulation of the unit, during the process, by using a projector.

QRCC/CCSOF

⑤ Cables and Accessories, for normal operation.

⑥ Manuals: This unit is **supplied with 8 manuals:** Required Services, Assembly and Installation, Interface and Control Software, Starting-up, Safety, Maintenance, Calibration & Practices Manuals.

*** References 1 to 6: QRCC + QRCC/CIB + DAB + QRCC/CCSOF + Cables and Accessories + Manuals are included in the minimum supply, enabling a normal operation.**

Continue...

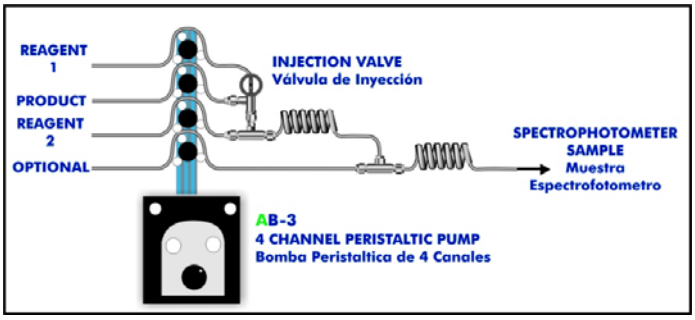
Optional Accessory

- QRCC-IF. **Flow Injection Analysis (FIA) Unit.**

This unit is a Flow Injection Analysis system, which we will use to measure the conversion degree of the reaction of the saccharose hydrolysis in a continuous way.

This unit provides an easy method for measuring the saccharose concentration of the final product in continuous way without the need of the measuring it manually. The unit can also be useful for the teaching of the FIA technique and the demonstration of the advantages of this measuring method in continuous processes.

It consists of a peristaltic pump with four channels that is used to impulse the right quantities of the final product together with reagents that colour it. Then the solution are put through coil reactor in order to complete the mixture. The last stage of the QRCC-IF involves passing the reaction through the spectrophotometer measuring cell.



Specifications:

Four channels peristaltic pump, 0.01-35 ml/min. for each channel, computer controlled (PC).

6 ports injection valve.

Coil reactor.

Continuous measuring cell for spectrophotometer.

Dimensions: 500 x 500 x 350 mm. approx.

Weight: 15 Kg. approx.

Complementary items to the standard supply

PLC. Industrial Control using PLC (7 and 8):

⑦ PLC-PI. PLC Module:

Circuit diagram in the front panel.

Front panel:

Digital inputs(X) and Digital outputs (Y) block:

16 Digital inputs, activated by switches and 16 LEDs for confirmation (red).

14 Digital outputs (through SCSI connector) with 14 LEDs for message (green).

Analog inputs block:

16 Analog inputs (-10V. to + 10V.)(through SCSI connector).

Analog outputs block:

4 Analog outputs (-10V. to + 10V) (through SCSI connector).

Touch screen:

High visibility and multiple functions.
Display of a highly visible status. Recipe function.
Bar graph function. Flow display function. Alarm list.
Multi language function.
True type fonts.

Back panel:

Power supply connector.
Fuse 2A.
RS-232 connector to PC.

Inside:

Power supply outputs: 24 Vdc, 12 Vdc, -12 Vdc, 12 Vdc variable.

Panasonic PLC:

High-speed scan of 0.32 μsec. for a basic instruction.
Program capacity of 32 Ksteps, with a sufficient comment area.
Free input AC voltage(100 to 240 V AC).
DC input:16 (24 V DC). Relay output: 14 (250 V A AC/2 A).
High-speed counter. **Multi-point PID control**.

Digital inputs/outputs and analog inputs/outputs Panasonic modules.

Communication RS232 wire, to computer (PC).

PLC-PI

⑧ QRCC/PLC-SOF. PLC Control Software:

For this particular unit, always included with PLC supply.

Items available on request

⑨ QRCC/CAL. Computer Aided Learning Software (Results Calculation and Analysis).

⑩ QRCC/FSS. Faults Simulation System.

EXERCISES AND PRACTICAL POSSIBILITIES

Some Practical Possibilities of the Unit:

1.- Study of the principles of packed bed catalytic reactors.
2.- Checking the influence on different variables (feed flow, temperature of reaction, reagents concentration) on the obtained final product.
3.- Studies of steady and unsteady state catalysis.
4.- Flow characterisation in a packed bed.
5.- Effect of the variation in the particle´s size in the effectiveness of a fixed-bed reactor.
6.- Mass balancing.
7.- Determination of steady state and unsteady state kinetics of a packed bed catalytic reactor.
8.- Effect of flow rate, temperature and feed concentration on steady state conversion.
9.- Performance comparison of a chemical catalyst (ionic exchange resins) with a biological catalyst (immobilized enzyme).
10.- Comparison of chemical and biological (enzymic) catalysis.
11.- Spectrophotometer calibration.
12.- Using the spectrophotometer and product analysis.
13.- Study of the FIA Flow Injection Analysis technique and principles (with QRCC-IF accessory).
14.- Examination of the reproducibility and sensitivity of the FIA analysis method as a function of the flow rate and sample concentration (with QRCC-IF accessory).

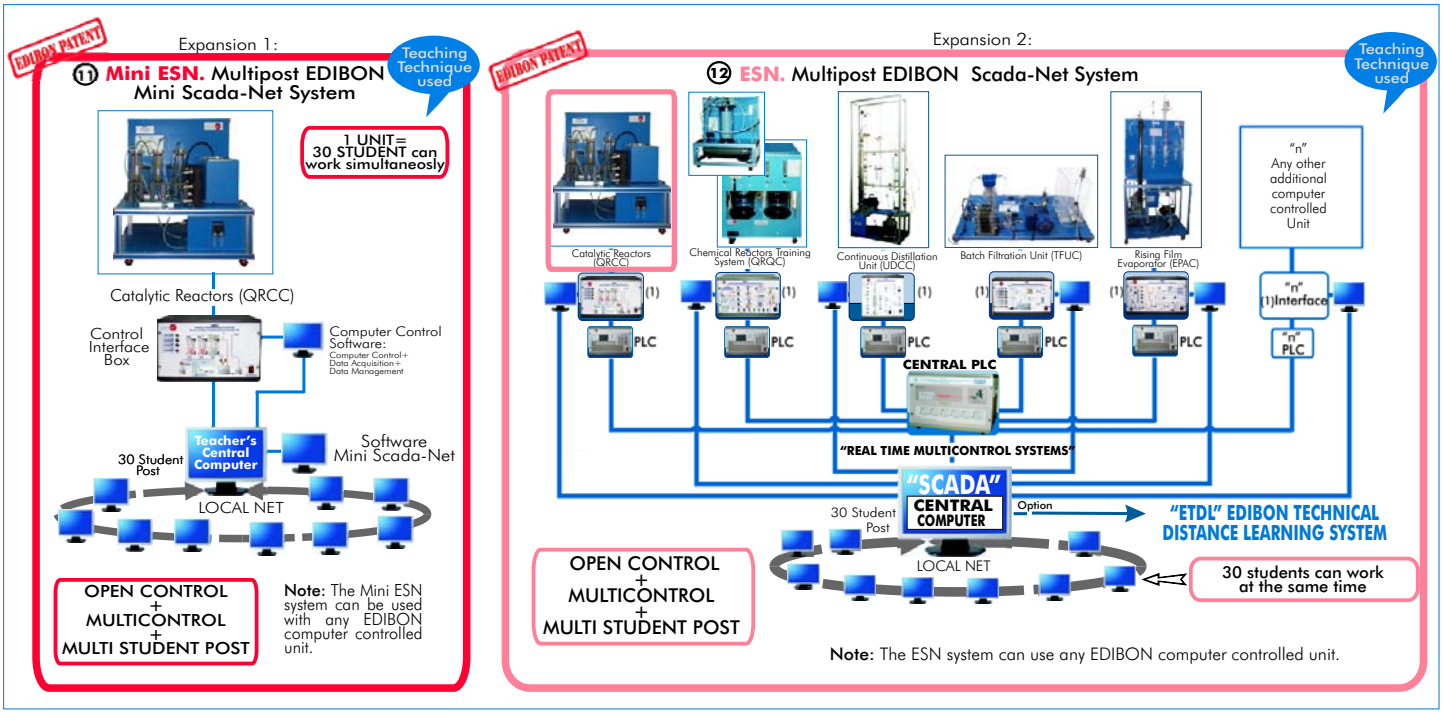
Other possible practices:

15.- Sensors calibration.

Practices to be done by PLC Module (PLC-PI) + PLC Control Software:

16.- Control of the QRCC unit process through the control interface box without the computer.
17.- Visualization of all the sensors values used in the QRCC unit process.
18.- Calibration of all sensors included in the QRCC unit process.
19.- Hand on of all the actuators involved in the QRCC unit process.
20.- Realization of different experiments, in automatic way, without having in front the unit. (This experiment can be decided previously).
21.- Simulation of outside actions, in the cases do not exist hardware elements. (Example: test of complementary tanks, complementary industrial environment to the process to be studied, etc).
22.- PLC hardware general use and manipulation.
23.- PLC process application for QRCC unit.
24.- PLC structure.
25.- PLC inputs and outputs configuration.
26.- PLC configuration possibilities.
27.- PLC program languages.
28.- PLC different programming standard languages (literal structured, graphic, etc.).
29.- New configuration and development of new process.
30.- Hand on an established process.
31.- To visualize and see the results and to make comparisons with the QRCC unit process.
32.- Possibility of creating new process in relation with the QRCC unit.
33.- PLC Programming Exercises.
34.- Own PLC applications in accordance with teacher and student requirements.

POSSIBILITIES OF OTHER AVAILABLE EXPANSIONS



ORDER INFORMATION

Items supplied as standard

Minimum configuration for normal operation includes:

① **Unit: QRCC. Catalytic Reactors.**
② **QRCC/CIB. Control Interface Box.**
③ **DAB.Data Acquisition Board.**
④ **QRCC/CCSOF. Computer Control + Data Acquisition + Data Management Software.**
⑤ **Cables and Accessories**, for normal operation.
⑥ **Manuals.**

* **IMPORTANT: Under QRCC we always supply all the elements for immediate running as 1, 2, 3, 4, 5 and 6.**

Complementary items to the standard supply

PLC. Industrial Control using PLC (7 and 8):

⑦ PCL-PI.PLC Module.
⑧ QRCC/PLC-SOF. PLC Control Software.
⑨ QRCC/CAL. Computer Aided Learning Software (Results Calculation and Analysis). (Available on request).
⑩ QRCC/FSS. Faults Simulation System. (Available on request).

Expansions

⑪ Mini ESN. Multipost EDIBON Mini Scada-Net System.
⑫ ESN. Multipost EDIBON Scada-Net System.

REQUIRED SERVICES

-Electrical supply: single-phase, 220 V./50Hz. or 110V./60Hz.
-Water to fill the thermostatic bath.
-Computer (PC).

DIMENSIONS & WEIGHTS

QRCC. Unit :	-Dimensions: 650 x 700 x 800 mm. approx.
	-Weight: 50 Kg. approx.
Spectrophotometer:	-Dimensions: 470 x 380 x 140 mm. approx.
	-Weight: 10 Kg. approx.
Control Interface Box:	-Dimensions: 490 x 330 x 310 mm. approx.
	-Weight: 10 Kg. approx.
PLC Module (PLC-PI):	-Dimensions: 490 x 330 x 310 mm. approx.
	-Weight: 30 Kg. approx.

OPTIONAL ACCSSORY

-QRCC-IF. Flow Injection Analysis (FIA) Unit.

AVAILABLE VERSIONS

Offered in this catalogue:

-QRCC. **Computer Controlled Catalytic Reactors.**

Offered in other catalogue:

-QRCB. **Catalytic Reactors.**

✱ Specifications subject to change without previous notice, due to the convenience of improvements of the product.

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